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Morphometric Analysis as an Application Tool to Differentiate Three Local Pen Shells Species

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ABSTRACT

Pen shells are generally large bivalves, triangular in shape with light yellow-brown to dark brown colour. They live with their pointed end embedded in sediment, attached by abundant fine byssal threads. Pen shells are relatively common at the sandy substrate of the seagrass beds inhabited by *Enhalus acoroides*, *Halophila* spp. and *Cymodocea serulata,* shallow lagoons and coral rubble areas. Specimens of *Pinna bicolor* Gmelin, *Pinna deltodes* Menke and *Pinna atropurpurea* Sowerby were collected from the seagrass beds of Merambong Shoal, Tanjung Adang Shoal and Merambong Island off South Western coast, of Johor, Peninsular Malaysia for morphological studies from August 2005 to June 2006. Naturally, *P. deltodes* is largely found on hard bottom substrate while, *P. bicolor* and *P. atropurpurea* are more associated with soft substrate. Physically, there was no significant external morphological difference between *P. bicolor, P. deltodes* and *P. atropurpurea.* The species was identified on the basis of nine internal and external characteristics of the valves. The three species were found to be morphologically different ($P<0.05$) on the basis of four major characteristics viz width of sulcus (WS), distance between posterior adductor muscle to posterior dorsal nacreous layer (PAMPDNL), dorsal posterior margin length (DPML) and shell width length (WL).

Keywords: Pen shells, Pinnidae, morphometric analysis

INTRODUCTION

Pen shells of the family Pinnidae are widely distributed in the Indo-Pacific from southeastern Africa to Melanesia and New Zealand, north to Japan and to New South Wales and New Zealand (Butler and Keough, 1981; FAO, 1998). Pen shells are also found in Mediterranean and American waters (Rosewater, 1961; Butler, 1987; Zavodnik *et al.,* 1991; Munguia, 2004). *Atrina* and *Pinna* species exist as metapopulations, composed of small groups or patches of individuals. Pen shells are generally large bivalves (30-48 cm long), triangular in shape, thin, shell tapering to a point and light yellow-brown to dark brown in color. Pen shells live with their pointed end embedded in sediments, attached by abundant fine byssal threads (Keen, 1958; FAO, 2002; Tyler-Walters, 2004).

The Pinnids are characterized by a unique, dorsal pallial organ and by the triangular shell shape associated with partial to almost complete burial in the substratum (Beesely *et al.,* 1998). They are extremely proneto breakage from the storm waves and shifting sands, but they have considerable potential of shell repair through utilization of several unique structures that remove debris from the mantel cavity and repositioning of the mantel to form new shell. Repaired shells are seldom shaped like the original, however resulting in great variation in form and sculpture (Rosewater, 1982).

For this reason it is often difficult to identify a specimen without careful examination and even then considerable experience with specific variation may be required to recognize a species with any degree of confidence. A few attempts

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have been made in the literature to present an orderly classification of *Pinnidae* in different areas of the world (Turner and Rosewater, 1958; Rosewater, 1961). The interior nacreous area is divided by an anteroposteriorly directed sulcus into dorsal and ventral lobes, and is a member of the genus *Pinna*. Examination on nacreous areas was distinguished to confirm their identity (Rosewater, 1982; Scheltema, 1983).

A previous report by Winckworth (1929) only described the morphology of pen shell from South India and Ceylon but not in full detail. Rosewater (1961) review provided a key to pen shells in the Indo-Pacific and identified three recent genera *Pinna, Atrina* and *Streptopinna* with seven species in Australia. Subsequently, Scheltema (1983) identified an eighth species.

Pen shells show considerable morphological variation creating taxonomic confusion for many taxonomists (Perry and Larsen, 2004). *Pinna* species are reported to exist with quite similar morphological characteristics when compared to *Atrina* species (Scheltema, 1983). Physically, *Pinna bicolor, P. deltodes and P. atropurpurea* are morphologically similar. Species cannot be differentiated based on shape, colour and others external morphologies. In Malaysia, most of the *Pinna* species live in the same habitat and substratum especially in muddy and sand muddy areas (Idris *et al.*, 2006).

At present, there has been no documentation on the fisheries aspects nor the taxonomic status of Malaysian water Pinnidae. This study started from August 2005 to June 2006. The aim of the study is to generate some information on the taxonomy of the pen shells in the Sungai Pulai seagrass beds. These areas were chosen because of the natural abundance of pen shells that are associated with the seagrasses. In this study, morphometric analysis was used as a tool to differentiate three *Pinna* species. Nine different morphometric characteristics were applied to differentiate three *Pinna* species existing in the study areas.

MATERIALS AND METHODS

Field Sampling of Pen Shell

Specimens of pen shell were collected from Merambong Shoal (N1° 19' 55.62" E103° 35' 57.75"), Tanjung Adang Shoal (N1° 19' 48.03" E103° 33' 59.44") and Merambong Island (N1° 18' 54.83" E103° 36' 33.37") off South Western Johor coast, Malaysia (*Fig. 1*) from August 2005 to June 2006.

By using a hand scope, specimens were removed from the substratum and placed into plastic bags and labeled. All specimens were placed on ice and immediately transported to the laboratory. For morphometric analysis, specimens were stored in a 70% ethanol solution for one week and then placed in a drying oven for 48 hour prior to analysis (Claxton *et al.*, 1997).

Morphometric Characters

Seventy nine individuals were collected from the study areas during low tide and were transferred to the laboratory for identification, labeled specimens were stored and images were taken and recorded. Shells were measured using MITUTOYO digital vernier caliper for total length and other shell morphometric characteristics.

The following parameters were measured :- length of anterior to posterior adductor muscle length (APAML) (1), posterior adductor muscle to posterior shell margin (PAMPSM) (2), dorsal posterior margin length (DPML) (3), dorsal margin length (DML) (4), width length (WL) (5), total length (TL) (6), width of sulcus (WS) (7) posterior adductor muscle to posterior dorsal nacreous layer (PAMPDNL) (8) and dorsal nacreous length (DNL) (9) (*Figs. 2C, 3C* and *4C*). For the identification of the various morphological structures on pen shell species, the methods of Winckworth (1929), Rosewater (1961), Butler and Keough (1981), Scheltema (1983), FAO (1998 and 2002) Ubukata (2002) and Perry and Larsen (2004) were used.

Statistical Analysis

Data was also analysed using SPSS (Statistical Package for Social Science) v13 computer statistical program to compare the means for every morphometric characteristic value between *P. bicolor, P. deltodes* and *P. atropurpurea*. One-way Analysis of variance (ANOVA) was used to compare the morphometric characters of each species. The Tukey HSD post-hoc test was then used to determine which of the characters was significantly different from the others. The morphometric shell measurement data was also used to determine the ratio between the morphometric characteristics of the *Pinna bicolor, P. deltodes* and *P. atropurpurea*.

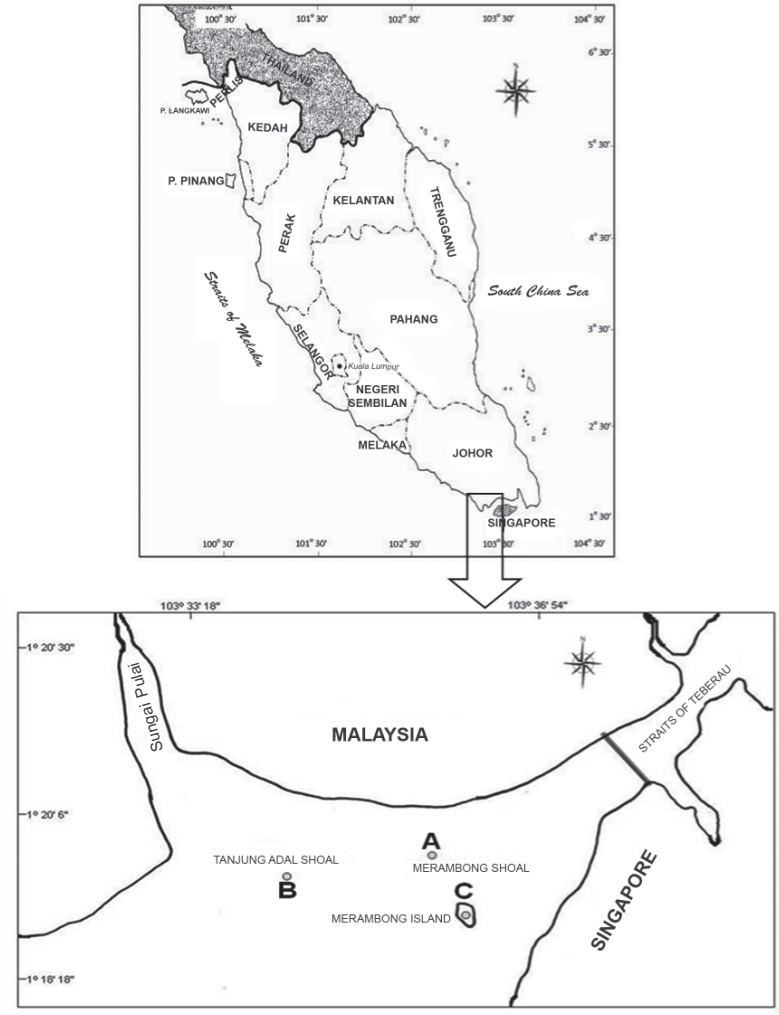

Fig. 1: Map showing the sampling areas. (A)Merambong shoal, (B)Tanjung Adang shoal and (C) Merambong island off South Western Johor coast, Malaysia

Principle component analysis (PCA) was carried out using the correlation matrix of the log-transformed morphometric variables (APAML, PAMPSM, DPML, DML, WL, TL, WS, PAMPDNL and NL) using the program PRIMER v5 (Plymouth Routines In Multivariate Ecological Research) (Clarke and Gorley, 2001). An inspection of the loadings on the principle components was done to determine which represented 'size' and had coefficients of the same sign and which represented 'shape' and had coefficients of mixed signs (Reyment *et al.*, 1984).

RESULTS

Morphometric Characters

A total of 39 specimens of *Pinna bicolor,* 19 specimens of *P. deltodes* and 21 specimens of *P. atropurpurea* were examined for non-overlapping character states. The range and mean values of different morphometric characters of the three local pen shells are shown in Table 1. Differences in the distribution of total width length, dorsal posterior margin length, posterior adductor muscle to posterior dorsal nacreous layer and width of sulcus distinguish *P. bicolor, P. deltodes* and *P. atropurpurea* and correlate with differences

TABLE 1
Analysis of variance (One-way ANOVA) of nine morphometric characteristics showed four characteristics were significantly different (P<0.05) between *P. bicolor*, *P. deltodes* and *P. atropurpurea*

Morphometric Characteristics	Species	N	Range (mm)	Mean (±SD)	F_{value}	Sig.
TL (mm)	*P. bicolor*	39	180.52 - 248.47	225.11(± 22.82)[a]	2.693	0.74[ns]
	P. deltodes	19	115.57 - 310.54	225.89 (± 52.95)[a]		
	P. atropurpurea	21	141.06 - 248.60	206.23 (± 31.09)[a]		
WL (mm)	*P. bicolor*	39	57.83 - 131.63	93.64 (± 18.23)[a]	9.05	0.00[*]
	P. deltodes	19	61.62 - 149.28	116.68 (± 22.16)[b]		
	P. atropurpurea	21	71.69 - 140.07	103.56 (± 19.19)[a,b]		
DML (mm)	*P. bicolor*	39	159.75 - 228.80	202.86 (± 21.17)[a]	2.614	0.80[ns]
	P. deltodes	19	109.86 - 266.16	200.97 (± 43.86)[a]		
	P. atropurpurea	21	58.16 - 240.13	182.87 (± 40.71)[a]		
DPML (mm)	*P. bicolor*	39	25.74 - 74.77	47.43 (± 12.56)[a]	22.772	0.00[*]
	P. deltodes	19	33.22 - 92.19	71.86 (± 16.69)[b]		
	P. atropurpurea	21	34.24 - 64.91	52.54 (± 9.82)[a]		
PAMPSM (mm)	*P. bicolor*	39	60.10 - 108.17	84.57 (± 11.97)[a]	0.942	0.39[ns]
	P. deltodes	19	49.10 - 132.43	89.74 (± 19.79)[a]		
	P. atropurpurea	21	66.48 - 105.14	84.87 (± 11.19)[a]		
APAML (mm)	*P. bicolor*	39	95.64 - 153.67	125.71 (± 14.90)[b]	4.937	0.10[ns]
	P. deltodes	19	58.22 - 161.12	120.39 (± 30.39)[a,b]		
	P. atropurpurea	21	71.83 - 138.38	108.28 (± 18.57)[a]		
DNL (mm)	*P. bicolor*	39	103.37 - 159.39	133.27 (± 13.79)[b]	3.471	0.30[ns]
	P. deltodes	19	61.09 - 169.03	129.13 (± 29.14)[a,b]		
	P. atropurpurea	21	67.39 - 144.21	118.88 (± 20.69)[a]		
PAMPDNL (mm)	*P. bicolor*	39	3.47 - 10.80	6.78 (± 2.34)[b]	19.984	0.00[*]
	P. deltodes	19	0.07 - 8.07	3.09 (± 2.23)[a]		
	P. atropurpurea	21	1.63 - 10.47	7.34 (± 2.49)[b]		
WS (mm)	*P. bicolor*	39	0.72 - 3.64	1.59 (± 0.60)[a]	65.381	0.00[*]
	P. deltodes	19	2.16 - 6.07	4.60 (± 1.34)[b]		
	P. atropurpurea	21	1.15 - 3.14	2.19 (± 1.05)[a]		

* highly significant at (P<0.05); ns=not significant at (P>0.05)
Mean±SD subjected to Tukey HSD Post-hoc test
Mean±SD in column with dissimilar superscript letter is significantly different (P≤0.05)

Abbreviations : TL=Total Length; WL=Width Length; DML=Dorsal Margin Length; DPML=Dorsal Posterior Margin Length; PAMPSM=Posterior Adductor Muscle to Posterior Shell Margin; APAML=Anterior to Posterior Adductor Muscle Length; NL=Dorsal Nacreous Length; PAMPDNL=Posterior Adductor Muscle to Posterior Dorsal Nacreous Layer; WS=Width of Sulcus

in position of the posterior adductor muscle scar in relation to the dorsal nacreous lobe (*Figs. 2C, 3C* and *4C*).

Analysis of variance (One-way ANOVA) showed that out of nine morphometric data, four characteristics (WL=Width Length, DPML=Dorsal Posterior Margin Length, PAMPDNL=Posterior Adductor Muscle to Posterior Dorsal Nacreous Layer and WS=Width of Sulcus) were highly significant (P<0.05) between *P. bicolor, P. deltodes* and *P. atropurpurea*. The graph of the means boxplots from nine morphometric characteristic also show four (B, D, H and I) morphometric characteristics that were significantly different for mean values of the morphometric characters between *P. bicolor, P. deltodes* and *P. atropurpurea* (*Fig. 5*).

The value of the first three principle components performed on the nine raw morphometric data are presented in Table 2 and *Fig. 6*. The positive and negative values indicate shape variation. The negative value was not considered as a good discriminant as shown by four characters (DPML= -1.02, PAMPSM= -0.35, PAMPDNL= -2.98 and WSL= -2.28) in the first component. The component loadings were also very high for most of the variables accounted for by the first principle component, which described 99.57% cumulative variance within the samples.

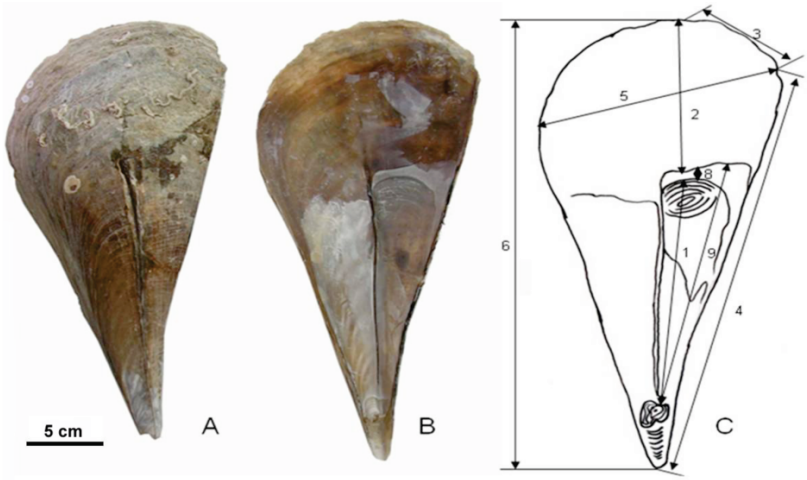

Fig. 2: Exterior of right valve of Pinna bicolor *showing (A) outer and inner surface, (B) internal view of left valve and(C) diagrammatic sketch of internal part of* P. bicolor *and the their characteristics view*

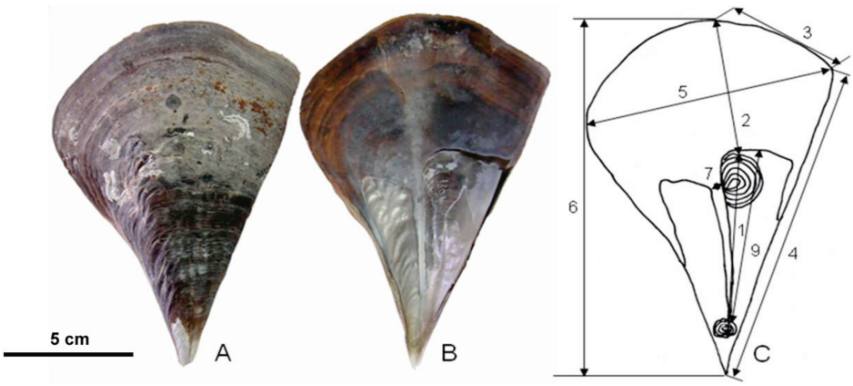

Fig. 3: Exterior of right valve of Pinna deltodes *showing (A) outer and inner surface, (B) internal view of left valve showing the posterior adductor muscle protruded on posterior margin of dorsal lobe and the width of sulcus between dorsal and ventral lobe of nacreous layer and (C) diagrammatic sketch of internal part of* P. deltodes *and the their characteristics view.*

Morphometric Ratio

An analysis of shell measurement and their ratio also showed significant differences ($P<0.05$) between *P. bicolor, P. deltodes* and *P. atropurpurea* (Table 3). The ratios on width length and total length, width of sulcus, posterior adductor muscle to dorsal posterior dorsal nacreous layer and anterior to posterior adductor muscle and posterior adductor muscle to posterior shell margin showed significant differences for the mean values.

Shell width length for *P. deltodes* and *P. atropurpurea* were three quarters of shell length and flared more posteriorly when compared to *P. bicolor*. The mean value of *P. deltodes* and *P. atropurpurea* were higher than *P. bicolor* with 116.68 ± 22.16 mm (n=19), 103.56 ± 19.19 mm (n=21) and 93.64 ± 18.23 mm (n=39) (*Fig.* 7, no. 5). *P. deltodes* also showed a higher value for dorsal posterior margin length with 71.86 ± 16.69 mm when compared to *P. bicolor* with 47.43 ±12.56 mm and *P. atropurpurea* with 52.54 ± 9.82 mm (*Fig.* 7, no. 3).

In all *P. deltodes* examined, the posterior adductor muscle scar was found to touch or near to the posterior edge of the dorsal nacreous lobe (*Fig. 8*, no. 8) whereas in *P. bicolor* and *P. atropurpurea* shells, the posterior adductor muscle

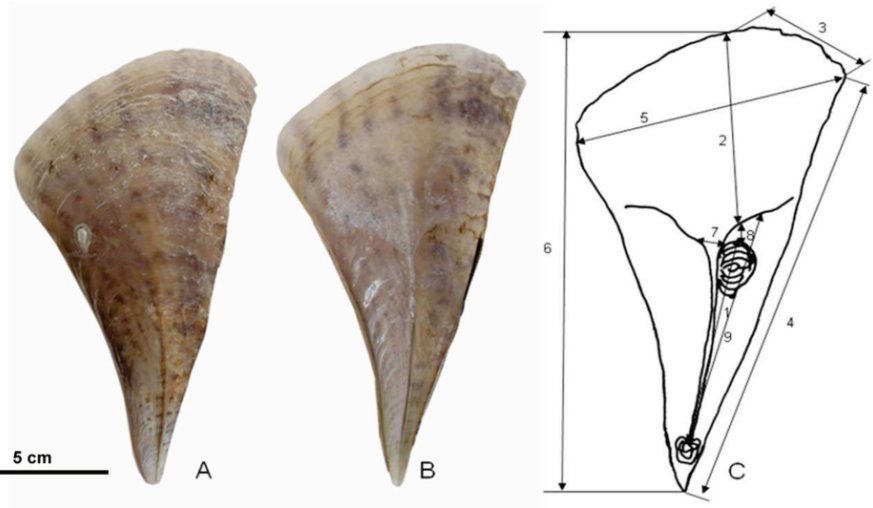

Fig. 4: Exterior of right valve of Pinna atropurpurea *showing (A) outer and inner surface, (B) internal view of left valve, showing dorsal and ventral lobes of nacreous layer forms posteriorly oblique truncated and sloping from sulcus and the nacreous lobes forming deep 'V' shape and (C) diagrammatic sketch of internal part of* P. atropurpurea *and the their characteristics view*

was always found to lie within the dorsal nacreous lobe (*Figs. 2C, 3C, 4C, 8D - F*, no. *8*). The mean values of posterior adductor muscle to posterior dorsal nacreous layer for *P. deltodes* was lower with a value of 3.09 ± 2.23 mm when compared to *P. bicolor* and *P. atropurpurea* with values of 6.78 ± 2.34mm and 7.34 ± 2.49mm respectively (Table 1).

The shape of the dorsal and ventral nacreous lobes was very obvious for the three specimens (*Figs. 2, 3, 4, 8 A-B* and *9*). Nacreous area iridescent, roughly occupying the anterior half of the shell and is divided along most of its length by a longitudinal sulcus. Dorsal and ventral lobes of nacreous area are moderately well separated. The dorsal lobe of the nacreous area for *P. bicolor* (*Figs. 2B, C, 8A*), usually extends farther posteriorly than the ventral lobe near to the sulcus. Its posterior margin is truncated to slightly oblique. Ventral lobe may extend obliquely farther posteriorly near the ventral margin or it is sometimes unevenly truncated and shorter than the dorsal lobe. The width of sulcus for *P. bicolor* was in the range of 0.72 mm - 3.64 mm with a mean value of 1.59 ± 0.60 mm (*Figs. 2C, 8A*, no.7).

In addition, *Pinna deltodes* (*Figs. 3B, C, 8B*) dorsal lobe occupies two-third of the shell. The dorsal nacreous area extends farther posteriorly than the ventral lobe and posterior margin was truncate. The ventral lobe extend obliquely farther posterior but quite far from the ventral margin or sometimes rounded and shorter than the dorsal lobe. The width of sulcus for *P. deltodes* ranged from 2.16 mm - 6.07 mm with a mean value of 4.60 ± 1.34 mm (*Figs. 3C, 8B,* no.7). The dorsal and ventral lobes of nacreous layer for *P. atropurpurea* showed similar high lobes and forming deep 'V' shape (*Figs. 4B, C, 8C*). The dorsal and ventral lobes of nacreous layer forms posteriorly, oblique truncated and sloping from sulcus. The width of sulcus ranged from 1.15 mm - 3.14 mm with a mean value of 2.19 ± 1.05 mm (*Fig. 4C,* no. 7).

DISCUSSION

Some morphometric characters of pen shell have been recorded by Scheltema (1983) based on the specimens of *P. deltodes* and *P. bicolor* from Australia. Only seven characteristics were measured during that study. In this study, two additional characteristics were included totaling nine characters for a more comprehensive conventional morphometric data analyses to determine the most appropriate for pen shell identification.

Physically, colour, size and shape cannot be used as indicators to differentiate these three *Pinna* species. Previously, Rosewater (1961) reported that *P. deltodes* and *P. atropurpurea* were

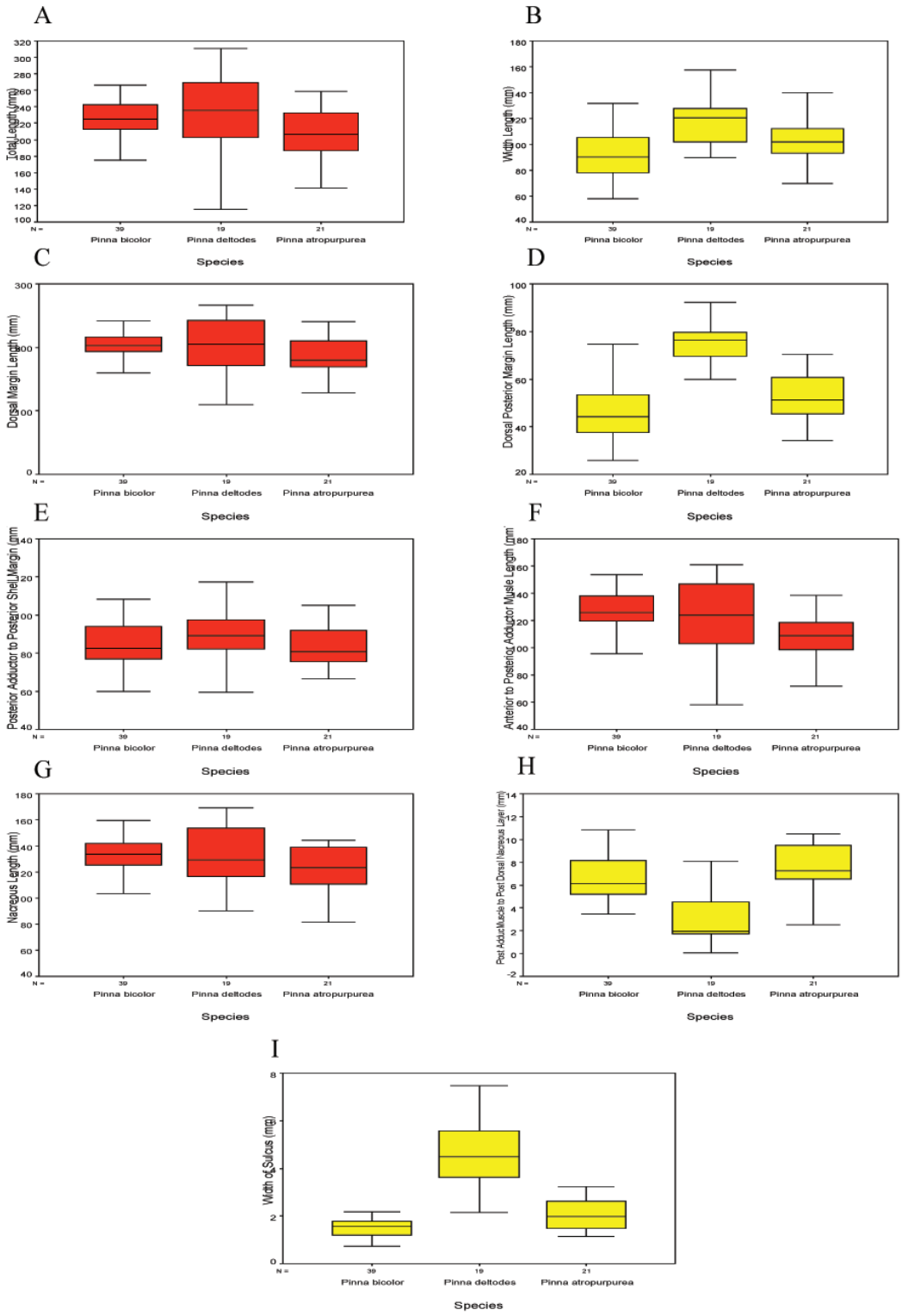

Fig. 5: Mean of boxplots from nine morphometric characteristic difference between P. bicolor, P. deltodes *and* P. atropurpurea

TABLE 2
Value of the first three components obtained through a PCA performed on raw morphometric data of three different species of pen shell

Morphometric Character (mm)	Component		
	1	2	3
TL	2.720	-0.010	-0.004
WL	0.075	-0.185	0.045
DML	2.152	0.049	-0.001
DPML	-1.028	-0.163	-0.064
PAMPSM	-0.358	-0.004	0.053
APAL	0.369	0.095	-0.037
DNL	0.577	0.078	-0.001
PAMPDNL	-2.219	0.096	0.029
WS	-2.289	0.043	-0.019
Eigen value	2.983	0.011	0.001
Cumulative Variance (%)	99.575	0.375	0.050

Abbreviations: TL=Total Length; WL=Width Length; DML=Dorsal Margin Length; DPML=Dorsal Posterior Margin Length; PAMPSM=Posterior Adductor Muscle to Posterior Shell Margin; APAML=Anterior to Posterior Adductor Muscle Length; DNL=Dorsal Nacreous Length; PAMPDNL=Posterior Adductor Muscle to Posterior Dorsal Nacreous Layer; WS=Width of Sulcus

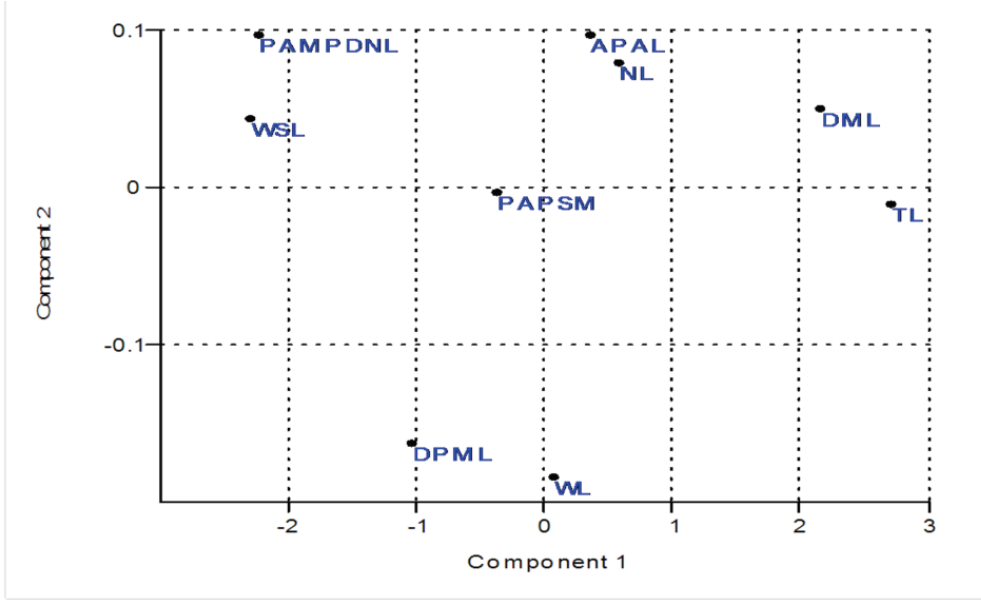

Fig. 6: Plots of coordinates of three different species of Pen Shells according to the first two discriminant functions, obtained from morphometric data

similar to *P. bicolor* based on external and internal characteristics. Some external morphological characters may be absent because of the broken shell especially at the posterior portion of the shell. For this reason we cannot get clear information to identify the specimens.

The results of ANOVA showed that of nine characteristics, four characters were highly significant ($P<0.05$) (width length-WL, dorsal posterior margin length-DPML, posterior adductor muscle to posterior dorsal nacreous layer-PAMPDNL and width of sulcus-WS) between

TABLE 3
Means and range of shell measurement and their ratio of *Pinna bicolor, Pinna deltodes* and *Pinna atropurpurea*

Measurement or Ratio*		*P. bicolor*	*P. deltodes*	*P. atropurpurea*
DPML (3) : TL (6)	Means	0.21 ± 0.45a	0.32 ± 0.50c	0.26 ± 0.39b
	Range	0.14 - 0.31	0.22 - 0.43	0.21 - 0.36
WL (5) : TL (6)	Means	0.42 ± 0.65a	0.52 ± 0.63b	0.50 ± 0.65b
	Range	0.30 - 0.56	0.40 - 0.60	0.39 - 0.65
DML (4) : TL (6)	Means	0.90 ± 0.40a	0.88 ± 0.53a	0.88 ± 0.12a
	Range	0.76 - 1.02	0.75 - 0.95	0.41 - 0.97
APAML (1) : PAMPSM (2)	Means	1.51 ± 0.23b	1.34 ± 0.19a	1.27 ± 0.13a
	Range	1.17 - 2.06	0.92 - 1.74	0.95 - 1.50
WS (7)	Means	1.47 ± 0.37a	4.60 ± 1.35c	2.20 ± 1.04b
	Range	0.94 - 2.17	2.16 - 7.46	1.15 - 3.23
DNL (9) : TL (6)	Means	0.59 ± 0.37b	0.57 ± 0.38a	0.57 ± 0.35a,b
	Range	0.53 - 0.69	0.52 - 0.64	0.48 - 0.64
PAMPDNL (8)	Means	6.79 ± 2.34b	2.68 ± 1.58a	7.35 ± 2.49b
	Range	3.47 - 12.87	0.07 - 5.67	1.68 - 10.47

Mean±SD subjected to Tukey HSD Post-hoc test
Mean±SD in column with dissimilar superscript letter is significantly different (P≤0.05)

Abbreviations: TL=Total Length; WL=Width Length; DML=Dorsal Margin Length; DPML=Dorsal Posterior Margin Length; PAMPSM=Posterior Adductor Muscle to Posterior Shell Margin; APAML=Anterior to Posterior Adductor Muscle Length; DNL=Dorsal Nacreous Length; PAMPDNL=Posterior Adductor Muscle to Posterior Dorsal Nacreous Layer; WS=Width of Sulcus

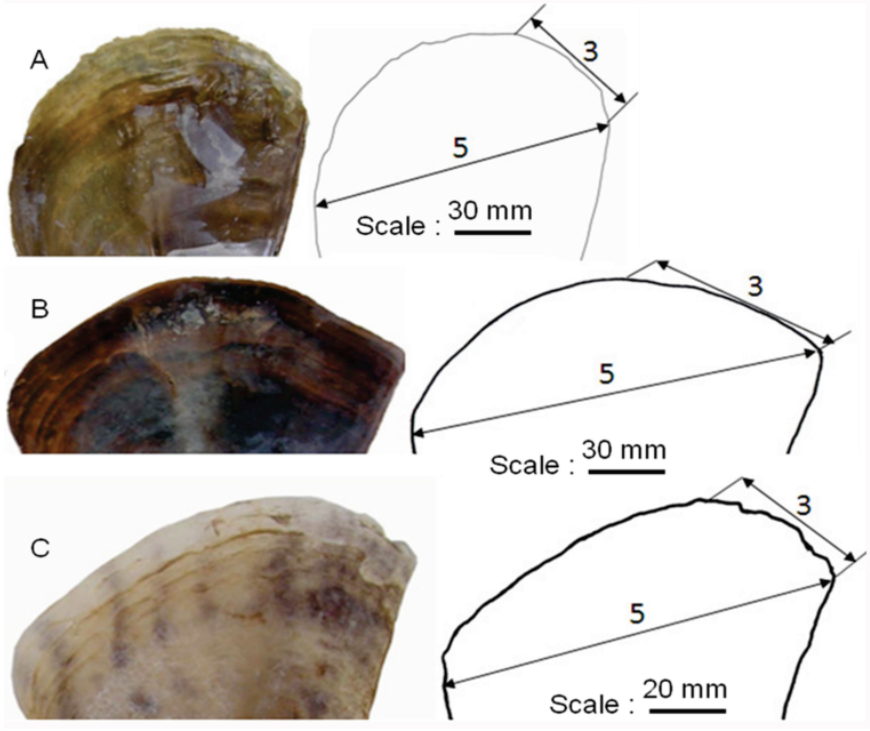

Fig. 7: Photo on posterior margin of the shell (A) P. bicolor; *(B)* P. deltodes; *(C)* P. atropurpurea *and their morphometric characters (no.3) DPML = Dorsal Posterior Margin Length; (no.5) WL = Width Length*

the three species of *Pinna*. The results showed that the same four morphometric characteristics resulted in highly significant (P<0.05) differences between the characters of the three *Pinna* species. From the morphometric analysis, the four characters showed clear characteristics for differentiating the three species (*P. bicolor, P. deltodes* and *P. atropurpurea*) from Malaysian waters.

Although shell shape is markedly variable in the three species, each has a common and distinct shape with *P. deltodes* and *P. atropurpurea* usually nearly symmetrical and *P. bicolor* typically asymmetrical (*Figs. 2, 3* and *4*). The difference in shape can be expressed by the ratio between the length of the dorsal posterior margin and longest shell length (Scheltema, 1983). From the examination, dorsal posterior margin were more than double in *P. deltodes* and *P. atropurpurea* compared to *P. bicolor*. The width of shell is about one-half of the shell length in *P. bicolor* and nearly three-quarter the shell length in *P. deltodes* and *P. atropurpurea* (Table 3).

The pattern of the nacreous layer and the position of the posterior adductor muscle scar determine generic and species membership in the Pinnidae (Turner and Rosewater, 1958; Rosewater, 1961). Unique to the genus *Pinna* is the sulcus which divides the nacreous area into dorsal and ventral lobes (*Figs. 2C, 3C* and *4C*, no. 7). An examination of all *P. bicolor* and *P. deltodes* shells by Scheltema (1983) in several museums showed no overlap of these two character states in specimens from Australia.

The position of the posterior adductor muscle scar of *P. deltodes* lies anterior to the mid-point of the shell in more than one-half of the specimens examined. Usually the posterior adductor muscle scar of *P. deltodes* protruded to the posterior dorsal nacreous layer but not in *P. bicolor*. The greater shell width of *P. deltodes* is reflected internally in the greater width of the sulcus between the nacreous lobes, which is on average twice as wide as in *P. atropurpurea* and triple in *P. bicolor*. The other five morphometric characteristics in these three species were found to be similar to each other.

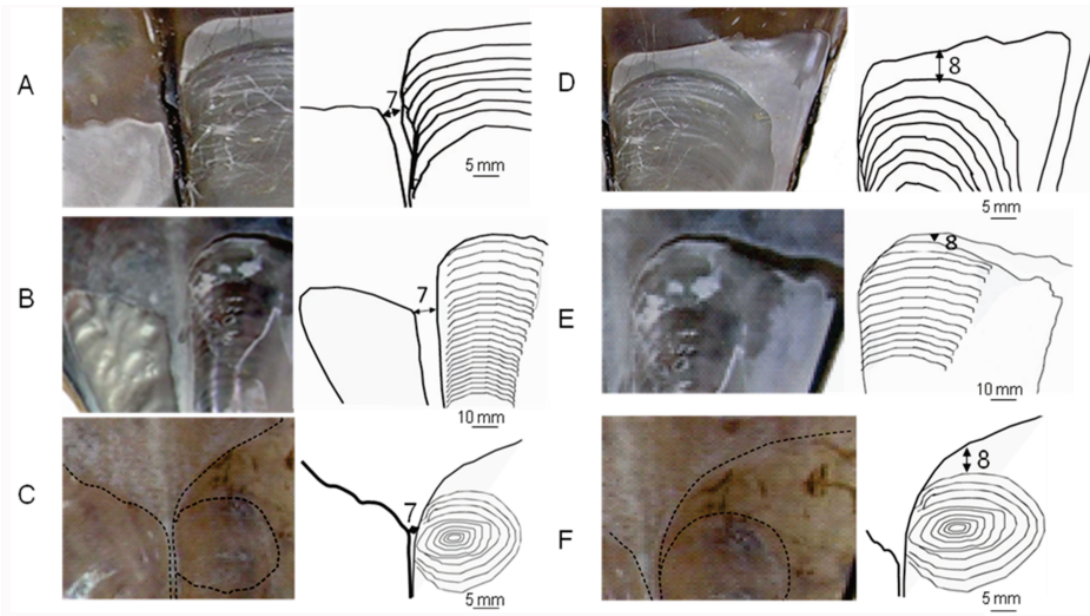

Fig. 8: Photo and diagrammatic sketch of different characters for width of sulcus and posterior adductor muscle scar located. A - C = Width of sulcus (no. 7) (A - P. bicolor, *B* - P. deltodes, *C* - P. atropurpurea*) and D - E = Posterior adductor muscle scar located (no. 8) (D* - P. bicolor, *E* - P. deltodes, *F* - P. atropurpurea*)*

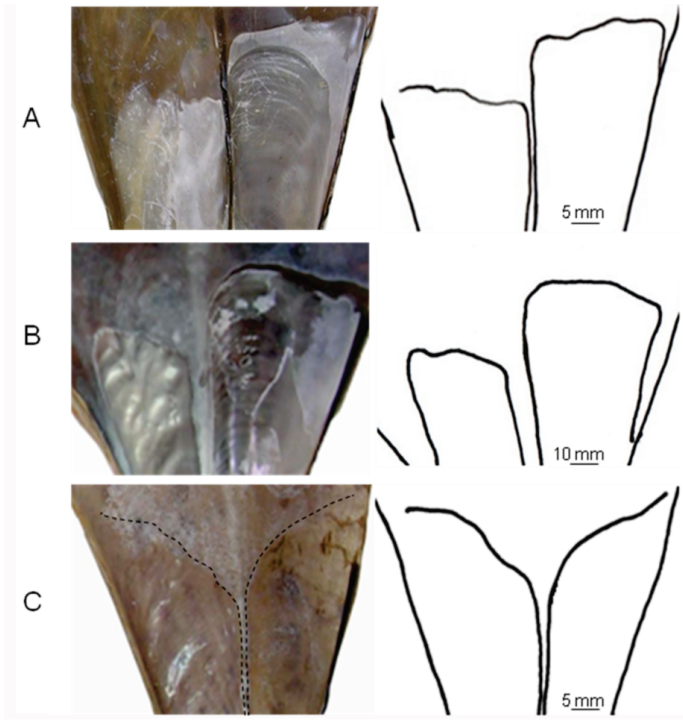

Fig. 9: Different shapes of nacreous lobe of three Malaysian Pen Shells. A - P. bicolor; *B* - P. deltodes *and C* - P. atropurpurea

CONCLUSIONS

From this study it could be concluded that Merambong shoal, Tanjung Adang shoal and Merambong island seagrass beds provided a habitat for *Pinna bicolor*, *Pinna deltodes* and *Pinna atropurpurea*. Nine internal and external morphological characteristics have been established for taxonomic identification. Differences in the four morphometric (width length-WL, dorsal posterior margin length-DPML, posterior adductor muscle to posterior dorsal nacreous layer-PAMPDNL and width of sulcus-WS) characteristics distinguish *Pinna bicolor*, *Pinna deltodes* and *Pinna atropurpurea* found in Malaysian waters.

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